

UNITED STATES SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN that WE, BERTRAM RUPIETTA, GÜNTER BECKER and GUNTHER SCHILLER, all citizens of Germany, having addresses of Im Handbachtal 38, D-46147 Oberhausen, Germany; Am Silberberg, D-65322 Aarbergen, Germany; and Westpreussenstrasse 7, D-65582 Diez, Germany, respectively, have invented certain new and useful improvements in a

METHOD AND DEVICE FOR THE
PRODUCTION OF A MULTI-LAYER CONCRETE PIPE

of which the following is a specification.

DESIGNATION OF INVENTORS

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TITLE: METHOD AND DEVICE FOR THE PRODUCTION OF A
MULTI-LAYER CONCRETE PIPE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a compacting tool, particularly a pressing head, for the production of a multi-layer concrete pipe in a mold mantle or the like. The compacting tool has at least one shaping tool comprising a distributor roller or pressing roller and/or at least one pressing piston or smoothing piston. The roller or piston has an outer mantle surface for shaping an inside wall of the concrete pipe, and rotates about a driven axle. Furthermore, the invention relates to a device for the production of a concrete pipe, particularly a two-layer concrete pipe, using such a compacting tool, as well as to a method for the production of a multi-layer pipe.

2. The Prior Art

Such concrete pipes are used, for example, for municipal and industrial sewer systems. In this connection, the wall of such a pipe fulfills various functions. For example, the wall of the pipe must absorb the static and dynamic stresses that act on it from the outside, and the inside surface is exposed to the medium to be transported.

Therefore special properties, such as friction wear resistance, acid resistance, fire resistance, or the like, are often required for the inside surface. It is therefore practical to produce the wall of the pipe from several layers, whereby the layers differ from one another in their properties. In this connection, it is known to line such concrete pipes with an inner layer of an acid-resistant concrete mixture, which increases the resistance of the concrete pipe. Since acid-resistant concrete mixtures are significantly more expensive than conventional concrete mixtures, only a very thin layer of the acid-resistant concrete is used to line the inside of concrete pipes.

This thin layer of acid-resistant concrete is usually applied using a spin-coating process, in which the acid-resistant concrete mixture is introduced into a pipe that is lying horizontally. In this connection, the working step of spin-coating has to be carried out until the concrete has cured, at least in part, so that the pipe can be removed from the mold in a horizontal position, without being damaged. Since the horizontal production of pipes is very time-consuming, single-layer pipes are often produced using vertical production methods, using a pressing head or the

like. In the case of pipes produced vertically, coatings are applied to the inside surface subsequently, or so-called liners made of plastic are installed. The installation of these coatings, some of which are very expensive, requires additional production steps. In addition, there is no intimate connection, i.e. no chemical connection between the layers, so that over the course of time, these layers can separate.

In order to produce concrete pipes having different inside diameters, a compacting tool is shown in U.S. Patent No. 4,690,631. In this patent, the radial orientation of the pressing rollers can be adjusted via an adjustment lever. For this purpose, a threaded screw that fixes the adjustment lever in place is screwed out of one threaded hole and, after the adjustment lever has been adjusted, screwed into another threaded hole. The adjustment of the pressing rollers is time-consuming and consequently cannot be performed while the pipes are being produced.

SUMMARY OF THE INVENTION

It is therefore the task of the present invention to provide a compacting tool and a method of the type stated

initially, with which multi-layer concrete pipes can be produced more quickly and more economically, and the connection between the individual layers is improved.

This task is accomplished according to the invention in that the distributor roller or pressing roller and/or pressing piston or smoothing piston are connected with the driven axle by way of an adjustment device, in such a manner that the distance between the outer mantle surface and the driven axle can be changed. The adjustment device thereby allows changing the diameter of the compacting tool defined by the distributor rollers or rockers, or the pressing rollers, for example, in a defined manner, in order to produce concrete pipes having different inside diameters, using the same compacting tool. Since it is not necessary to move the compacting tool out of the mold mantle in order to activate the adjustment device, a two-layer or multi-layer concrete tube can be produced, using the compacting tool according to the invention, without changing the tool. Thus, it is possible, because of the radial adjustability of the compacting tool, to first produce the outer layer of the concrete pipe, which has the larger inside diameter, and, after reducing the diameter of the compacting tool, to apply

the inner layer of the concrete pipe, which has a smaller inside diameter. In this connection, the radial adjustment of the compacting tool, by means of changing the diameter, takes place by varying the distance between the driven axle and the outer mantle surfaces of the rollers, rockers, or the like.

According to a preferred embodiment of the invention, the adjustment device has a connecting link guide that extends in a curved or straight path between two points, at different distances from the driven axle, and a sliding block that slides in the connecting link guide. The driven axle can be connected with a disk or the like, in which an oblong hole is formed as a connecting link guide. The bearing journal of a distributor roller or pressing roller or of a smoothing piston slides in the oblong hole as a sliding block. By rotating the compacting tool about the driven axle, the roller or the piston is forced into its rearward position in the connecting link guide, in the direction of rotation. By reversing the direction of rotation of the compacting tool about the driven axle, the roller or rocker can be forced into the other end position of the connecting link guide, which is at a different distance from the driven

axle, in comparison with the first position, so that the diameter of the compacting tool can be changed by reversing its direction of rotation.

The reversal of the direction of rotation of the compacting tool, between two work steps, can be used, alternatively, also in an adjustment device for changing the diameter of the compacting tool, if the adjustment device is formed by means of a pivot lever that is mounted eccentrically relative to the driven axle. This pivot lever is connected with the at least one distributor roller or pressing roller and/or the at least one pressing piston or smoothing piston at its end that faces away from the mounting, and can be pivoted between two points having a different distance from the driven axle. The contact points that delimit the pivot movement of the lever can be arranged in such a manner that contamination of the adjustment device by the concrete mixtures is avoided, to a great extent, so that no impairment of the precise adjustability of the diameter of the compacting tool occurs during operation.

According to another embodiment, the adjustment device has at least one electrically, hydraulically, or

pneumatically activated drive motor, which is assigned to the at least one distributor roller or pressing roller and/or the at least one pressing piston or smoothing piston, for adjustment. This drive motor, which can be a linear regulator, can centrally adjust all the rollers and/or pistons of the compacting tool, or can be assigned to individual rollers or pistons, or also to several rollers or pistons.

Preferably, the power supply of the drive motor is provided by means of the driven axle, which is formed by at least two coaxial hollow shafts that lie inside one another. In this connection, an electrical, hydraulic, or pneumatic line leads through the inner hollow shaft to the adjustment device.

As an alternative to this, it is also possible to form the driven axle by two coaxial hollow shafts that lie inside one another, and another shaft for driving the adjustment device is provided in the inner hollow shaft.

If the adjustment of the distributor roller or pressing roller is produced by the reaction force between the

roller and the concrete pipe provoked by a change in the direction of rotation, a power supplied by means of an axle configured as a shaft can be utilized for other functions. Thus, it is possible, for example, to use it to clean the distributor tool or pressing tool by means of compressed air or the like, or additional locking of the rollers in an end position can take place.

In order to achieve a particularly smooth inside wall and a homogeneous distribution of concrete in the walls of the pipes to be produced, a compacting tool according to the invention has a distributor having several distributor rollers or distributor rockers that act essentially radially, a compactor having several pressing rollers or compacting rockers that act essentially radially, and a smoothing tool. In this connection, the concrete that is filled into the mold mantle is first uniformly distributed in the mold mantle, and pre-compacted, by means of the distributor rollers of the distributor, so that any reinforcement of the concrete mixture is surrounded. In this connection, the pressing rollers of the compactor compact the concrete mixture to such an extent that the desired inside diameter of the concrete pipe is formed. Subsequently, the surface is finished using

the smoothing tool, which is preferably configured as a cylindrical piston and is arranged below the compacting tool.

As an alternative to the compacting tool described above, radially arranged slide rockers can also take over the distribution and compacting of the material, instead of the rollers.

The formation of torsion moments during the production of the concrete pipe using a pressing head can be avoided in that the distributor of the pressing head rotates about the longitudinal axis of the mold mantle in the opposite direction from the compactor. The compactor and the distributor can rotate at different speeds, if necessary. In this connection, the speed of the distributor is clearly higher than that of the compactor having the pressing rollers and the smoothing piston. In this manner, any reinforcement that might be present in the concrete pipe is also not twisted during the compacting process, so that it remains in its planned position.

According to another exemplary embodiment, a spray head for distributing and compacting concrete mixtures can be

arranged on the compacting tool, above the smoothing tool. The second concrete mixture for the inner layer of the concrete pipe, for example, can be distributed by means of centripetal forces that occur as a result of the rotating movement of the spray head. As a result of the impact velocity of the sprayed material onto the inside surface of the first concrete layer, the second concrete mixture is at least partially compacted, and the connection with the first concrete layer is improved. Consequently, it is possible to do without another distributor and/or an additional compactor.

The device according to the invention comprises at least one stand in which a compacting tool that can be driven is mounted, at least one turntable on which several mold mantles standing vertically can be pivoted into the stand in cycles, and at least one charging system for filling at least one concrete mixture into one of the mold mantles. Preferably, however, at least two charging systems are assigned to a stand, so that different concrete mixtures can be processed in the same stand.

It is preferred if at least one of the charging systems has a concrete silo having an assigned filling belt. As an alternative or in addition to this, the charging system can also be formed by a concrete pump having a pump hose. The use of a concrete pump can be sufficient, in particular, for supplying the second concrete mixture, for example a fire-resistant and/or acid-resistant concrete mixture, of which only a small volume proportion is needed for the production of a multi-layer concrete pipe.

The invention also comprises a method for the production of a multi-layer concrete pipe, particularly a two-layer concrete pipe, which comprises the following steps: first, a mold mantle standing essentially vertically is pivoted into a stand and the mold mantle is filled with a first concrete mixture from a first charging system. This first concrete mixture is then distributed and compacted in the mold mantle by means of a rotating and vertically displaceable compacting tool, and the inside surface is smoothed, if necessary. Before the concrete pipe is removed from the mold, a second concrete mixture is filled into the mold mantle that is standing essentially vertically, by means of a second charging system. In addition, the diameter of

the compacting tool is reversibly reduced, so that the second concrete mixture can be distributed and compacted using the compacting tool, and the inside surface can be smoothed, if necessary, before the concrete pipe is pivoted out of the stand and removed from the mold. With this method, neither a change in the compacting tool nor a transport of the outer part of the multi-layer concrete pipe, together with the mold mantle, to a second stand is required. Instead, the compacting tool can be changed in size, within the mold mantle, even before the second concrete mixture is introduced. After the concrete pipe has been pivoted out and removed from the mold, the diameter of the compacting tool is then reversibly enlarged again, to distribute and compact the first concrete mixture of a new concrete pipe.

Preferably, the direction of rotation of the compacting tool is changed after the first concrete layer has been distributed and compacted. In this manner, it is possible to change the radial alignment of tools that can be displaced in a connecting link guide or are mounted on a pivoting lever, relative to the driven axle, so that the diameter of the compacting tool is adjusted. As an alternative or in addition to this, it is also possible to

change the speed of rotation of the compacting tool after the distribution and compacting of the first concrete mixture. In this manner, the diameter of the compacting tool can be varied as the result of centripetal forces, for example.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and features of the present invention will become apparent from the following detailed description considered in connection with the accompanying drawings. It is to be understood, however, that the drawings are designed as an illustration only and not as a definition of the limits of the invention.

In the drawings, wherein similar reference characters denote similar elements throughout the several views:

FIG. 1 shows a compacting tool according to a first embodiment of the invention;

FIG. 2 shows a compacting tool according to a second embodiment of the invention;

FIG. 3 shows a compacting tool according to a third embodiment of the invention;

FIG. 4 shows a compacting tool according to a fourth embodiment of the invention; and

FIG. 5 shows a cross-sectional view of a pipe during its production.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In Figures 1 to 4, a compacting tool is indicated by a circular disk 1, which is connected with a driven axle 2. On disk 1, a connecting link guide 3 configured as an oblong hole according to the embodiment according to FIG. 1, is provided. A bearing journal 4, which carries a pressing roller 5, is displaceably mounted in the connecting link guide 3. In this manner, the pressing roller 5, together with the bearing journal 4, can be switched between the first position, indicated with a solid line in FIG. 1, having a smaller diameter, into a second position, indicated with a broken line, having a larger diameter.

The two end points of the connecting link guide 3 have a different distance from driven axle 2. The center of the bearing journal 4 describes a circle that is shown in the figures as D_{k1} , in its first position, when the disk rotates about the axis. After a displacement, indicated by the arrows in FIG. 1, of the bearing journal 4 into the second position, shown with a broken line, the center of the bearing journal describes a circle D_{k2} , the diameter of which is greater than that of the circle D_{k1} , during the rotation of the disk 1. In this manner, the size of the circles D_{R1} and D_{R2} described by the outside surfaces of the pressing roller 5 during a rotation of the compacting tool also changes. In this way, different wall thicknesses can be produced using a single compacting tool, in the production of a concrete pipe, without requiring a tool change.

In the case of the embodiment of the compacting tool shown in FIG. 1, the adjustment of the pressing roller 5 in the connecting link guide 3 is brought about by means of a reaction force. When the disk 1 rotates counter-clockwise, in operation, a reaction force occurs at the pressing roller 5, because of the contact with the inside wall of the concrete pipe, which forces the former into the first

position characterized with a solid line, in which the roller 5 lies closer to the driven axle 2. By changing the direction of rotation, an opposite reaction force results from the contact with the inside wall of the concrete pipe, which displaces the pressing roller 5 with the bearing journal 4 into the other end position of the connecting link guide 3, shown with a broken line in the figure. In this manner, the diameter of the circle D_{R1} described by the outer mantle surfaces of the pressing rollers during rotation of the compacting tool is increased to D_{R2} solely by changing the direction of rotation of the compacting tool.

In the embodiment shown in FIG. 2, the pressing roller 5 is also arranged to rotate on a bearing journal 4 that can be displaced in a connecting link guide 3, in such a manner that the size of the circle described by the outside mantle surface of the pressing roller during a rotation of the compacting tool can be changed. However, in this embodiment, the adjustment of the pressing roller between the two positions shown with a solid line and a broken line, respectively, does not take place exclusively by way of changing the direction of rotation of the compacting tool, but alternatively or in addition to this can take place by

means of a linear regulator 6 that engages on the bearing journal 4. In this manner, it is possible to adjust the diameter of the circle described by the outside surface of the pressing roller during rotation in step-free manner.

Another embodiment of the invention is shown in FIG. 3. A lever 7 is mounted on the disk-like compacting tool 1, eccentric to the driven axle 2, to pivot about a mounting point 8. The end of the lever 7 that faces away from the mounting 8 carries a bearing journal 4, on which the pressing roller 5 is mounted to rotate. Furthermore, two contact points 9a and 9b are arranged on the disk 1, which limit the pivoting movement of the lever 7. In this connection, the contact points 9a and 9b are positioned on the disk 1 in such a manner that when the lever 7 makes contact with the two contact points, the size of the circles D_{R1} and D_{R2} described by the mantle surface of the pressing roller 5 during rotation of the compacting tool is different.

As already explained above, with reference to FIG. 1, reaction forces directed in different directions, as a function of the direction of rotation of the compacting tool, are in effect during a rotation of the compacting tool 1, by

means of the contact of the outer mantle surface of the pressing roller 5 against the inside wall of the concrete pipe. By means of these reaction forces, the lever 7 is pivoted between the two positions that are shown in FIG. 3 with a solid line and a broken line, respectively, which are defined by the contact points 9a and 9b. Therefore concrete pipes having different wall thicknesses or having different inside diameters can be produced without changing the compacting tool, solely by changing the direction of rotation.

The structure of the compacting tool shown in FIG. 4 essentially corresponds to that of the embodiment according to FIG. 3. However, the lever 7 and the bearing journal 4, respectively, are connected with the linear regulator 6 explained above, with reference to FIG. 2, in such a manner that the lever 7 can be pivoted independent of the direction of rotation of the compacting tool 1, by means of the linear regulator 6. In this manner, the distance between the mantle surface of the pressing roller 5 that is in contact with an inside wall of a concrete pipe, and the driven axle 2 of the compacting tool 1, can be adjusted in step-free manner.

FIG. 5 shows two production steps in the production of a two-layer concrete pipe 10, whereby the right half shows the compacting of a first outer layer 10a using the compacting tool 1, in its second position shown with a broken line in Figures 1 to 4, while the application of a second, inner layer 10b, in the first position of the compacting tool, shown with a solid line in Figures 1 to 4, is shown in the left half of FIG. 5.

The compacting tool comprises, in addition to the pressing roller 5 already shown in Figures 1 to 4, distributor rollers 11 arranged above roller 5, which are also mounted to rotate on bearing journals 12, as well as a smoothing piston 13, which is arranged below the pressing roller 5. In contrast to the embodiment of Figures 1 to 4, several pressing rollers 5 and several compacting rollers 11 can be provided in the compacting tool, which, in each instance, can be individually positioned at different distances from the driven axle 2, by means of an adjustment device described above, making reference to Figures 1 to 4, as can the smoothing piston 13 or segments of the smoothing piston 13.

The production of the multi-layer concrete pipe 10 takes place in a vertically standing mold mantle 14, in which concrete is introduced to produce the outer layer 10a by means of the driven axle 2. At the beginning of the production process, the compacting tool is in a position in which it is completely retracted into the mold mantle 14, in which the distributor rollers 11 are positioned approximately at the bottom end of the mold mantle 14. The distributor rollers 11, the pressing rollers 5, as well as the smoothing piston 13, are located in the second position, shown with a broken line in Figures 1 to 4, so that the circle described by the mantle surfaces of the pressing rollers 5 during a rotation of the compacting tool about the axle 2 corresponds to the circle D_{R2} shown with a broken line in Figures 1 to 4. At the same time that the concrete mixture is filled in, the compacting tool is put into rotation by the driven axle 2, and pulled vertically upwards, out of mold mantle 14. As this happens, distributor rollers 11 first distribute the concrete mixture uniformly on the inside wall of mold mantle 14, whereby pre-compacting of the concrete can take place. The concrete is further compacted by pressing rollers 5, which preferably rotate about axle 2 in the opposite direction from distributor rollers 11. The smoothing piston

13 finally smooths inside wall surface of outer layer 10a of the concrete pipe.

To form inner layer 10b of concrete pipe 10, the compacting tool is again moved to its bottom position in mold mantle 14, and distributor rollers 11, pressing rollers 5, as well as smoothing piston 13 are brought into a position having a reduced distance from the driven axle 2, in the manner described above, making reference to Figures 1 to 4. During or after introduction of the material for inner layer 10b of the concrete pipe, this inner layer is produced by means of distributor rollers 11, pressing rollers 5, as well as smoothing piston 13, as described above. Subsequently, concrete pipe 10 can be removed from mold mantle 14.

Accordingly, while only a few embodiments of the present invention have been shown and described, it is obvious that many changes and modifications may be made thereunto without departing from the spirit and scope of the invention.

Reference Symbol List

1	disk (compacting tool)
2	driven axle
3	connecting link guide
4	bearing journal
5	(pressing) roller
6	linear regulator
7	(pivot) lever
8	bearing
9a, 9b	contact point
10	concrete pipe
10a	outer layer
10b	inner layer
11	distributor roller
12	bearing journal
13	smoothing piston
14	mold mantle